Assessing the Relationship between Pain Catastrophizing and

Early Physical, Psychological, and Cognitive Symptoms

Following Mild Traumatic Brain Injury

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Abstract

Identifying determinants that shape the recovery course following a mild traumatic brain injury (MTBI) is clinically relevant as adverse MTBI outcomes significantly burden the healthcare system. This study aimed to determine whether pain catastrophizing (PC) influenced early MTBI clinical outcome. It was hypothesized that PC would be associated with greater pain severity and post concussive symptoms reports, increased psychological distress, and decreased level of functionality post head injury. This prospective design included 58 patients for which data from the Rivermead Post Concussion symptoms, Multidimensional Pain Inventory, and Pain Catastrophizing scale questionnaires were retrieved. Pearson’s correlations revealed to be positive and significant between PC and greater pain severity, post-concussion symptom reports, and psychological distress, respectively. Correlational analyses also demonstrated a negative relationship between PC and level of functionality post-MTBI. Overall, these findings suggest that PC adversely affects early MTBI outcome, and might be a risk factor for post concussion syndrome development.
Résumé

L'identification de facteurs influençant le rétablissement suite à un traumatisme crânien cérébral léger (TCCL) s'avère cliniquement pertinent compte tenu du fardeau imposé au système santé.

Cette étude visait à établir si la dramatisation envers la douleur (DD) influence le rétablissement précoce suite à un TCCL, en étant possiblement associée à plus de douleur, symptômes aigus, détresse psychologique, et, à une réduction du niveau de fonctionnalité.

Cette recherche prospective auprès de 58 patients fut basée sur les questionnaires Rivermead, Inventaire Multidimensionnel de la douleur, et Échelle de DD. Des corrélations de Pearson positives et significatives furent observées entre la DD et la sévérité de douleur, les symptômes post-TCCL, et la détresse psychologique. Les analyses corrélationnelles ont aussi illustré une relation négative entre la DD et le niveau de fonctionnalité. En somme, la DD semble affecter défavorablement le rétablissement précoce suite à un TCCL, et pourrait être un facteur de risque pour le développement d'un syndrome post-commotionnel.
Dedication

To my precious godchild Yesha Kate, whose untiring curiosity and fearless approach to new endeavours is a continuous and humbling life lesson to me. And in loving memory and honour of my Nanny, who has taught me so much through her altruistic nature and exemplary way of life, and who is a constant source of inspiration in my life.
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List of Abbreviations

DD: Dramatisation envers la douleur
ED: Emergency department
GCS: Glasgow coma scale
MPI: Multidimensional Pain Inventory
MTBI: Mild traumatic brain injury
PC: Pain catastrophizing
PCS: Post concussion syndrome
PCSx: Post concussion symptoms
RPQ: Rivermead Post Concussion Symptoms questionnaire
TBI: Traumatic brain injury
TCCL: Traumatisme crânien cérébral léger
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CHAPTER 1 - INTRODUCTION

Traumatic brain injury (TBI) results from an insult to the brain, not of a degenerative or congenital nature, but by an external physical force that may produce a diminished or altered state of consciousness (Martin, 2003). Profound disturbances of cognitive, emotional, and behavioral functioning after TBI may produce permanent impairments that result in partial or total functional disability and psychosocial maladjustment. Uncomplicated head injuries have classically been categorized as mild, moderate, or severe in gravity (Greenwald, 2003).

Predicting clinical outcome after a mild traumatic brain injury (MTBI) is notoriously difficult. With an incidence of 100 to 600/100 000 cases reported each year in North America (Cassidy, 2004a; Guidelines for Planning Brain Injury Services and Supports in British Columbia, 2002), traumatic brain injuries (TBI) are a significant public health concern as they can result in adverse outcomes that may persist for an extended period of time (Kraus, 2005; Yang, 2007). More specifically, the current literature suggests that mild traumatic brain injuries account for 80-90% of all TBIs, which translates into considerable economic costs for the healthcare system (Bay, 2007; Cassidy, 2004a; Max, 1991).

A multitude of physical, psychological, and neuro-cognitive symptoms are frequently reported following a MTBI, including headaches, fatigue, dizziness, sleep disturbances, feeling irritable
and/or depressed, altered ability to concentrate, as well as increased sensitivity to noises and/or lights (Alves, 1986; Bohnen, 1992b; Evans, 1992; Rutherford, 1989). While the resolution of these symptoms usually occurs within 1-3 months (Carroll, 2004a; Ponsford, 2000), patient reports of persisting neuropsychological symptoms months to years following the head injury remains a concerning problem (Boake, 2004; Deb, 1998; Ponsford, 2000). Moreover, pain is a significant problem following TBI, and more particularly after a milder traumatic brain injury (Martelli, 2002; Merskey, 1994; Nampiaparampil, 2008).

Indeed, although the mortality rate in MTBI patients is low (Yang, 2007), and neurosurgical interventions are rarely needed (Stulemeijer, 2006b), MTBI remains a considerable issue as symptoms and functional impairments persist in 5-15% of all patients for months to years following the head trauma (Alexander, 1995; Cassidy, 2004a; Iverson, 2005). This cluster of persistent symptoms has been defined as the post concussion syndrome (WHO, 1978).

To date, identifying the determinants that shape the early clinical presentation and overall outcome following a MTBI remains a significantly tedious yet undeniably important healthcare objective. Noteworthy research studies dedicated to elucidating such factors have been published in recent years, including literature contributions focusing on clinical (Heitger, 2006; Lundin, 2006; Smith-Seemiller, 2003), neuropsychological (Ingebritsens, 1998; Stulemeijer, 2006a), and rehabilitation (Cassidy, 2004a; Nolin, 2006) factors influencing MTBI.
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outcome. Despite this growing literature, given its associated epidemiological discrepancies and ensuing methodological challenges, and current contradictory report findings (Cattelani, 1996; Ponsford, 2000; Savola, 2003; Stulemeijer, 2008), further investigations including novel research territories must be conducted to fully identify and comprehend the variables influencing MTBI outcome. Such promising research avenues comprise assessing the role of coping styles such as pain catastrophizing tendencies in MTBI outcome. Pain catastrophizing, which is defined as an exaggerated appraisal of the negative components of an actual or anticipated pain experience (Sullivan, 2001; Turk, 1996), has been found to influence the course of numerous diseases and clinical procedures, including arthritis (Edwards, 2006), surgical procedures (Jacobsen, 1996), and burn dressing changes (Haythornthwaite, 2001), for example. Gaining a better understanding of the role of pain catastrophizing in MTBI outcome is clinically relevant as it might not only contribute to better patient care and quality of life through the improvement the current clinical management, but might also help reduce the direct and indirect costs associated with the care of patients who sustain a MTBI.

The next chapter consists in a comprehensive review of the literature, and contains 2 respective sections: one covering mild traumatic brain injuries (MTBI), and another reserved to the concept of pain catastrophizing (PC). In the first section, an overview of traumatic brain injuries (TBI), diagnostic criteria, epidemiological factors, and
natural clinical history are presented, including detailed sections on post-concussion symptoms, post-concussion syndrome and pain reports following MTBI. In the second section, factors thought to shape MTBI outcome are outlined. Secondly, the concept of pain catastrophizing is introduced, and covers both a historical review describing the origins of this appraisal and coping cognitive process, as well as its adverse consequences in a wide array of clinical entities and settings.
CHAPTER 2 – COMPREHENSIVE REVIEW OF LITERATURE

Section 1 - Mild Traumatic Brain Injuries

Overview of Traumatic Brain Injuries

Currently, traumatic brain injuries (TBI) are a significant healthcare concern, as they can result in adverse clinical outcomes (Chambers, 1996; Lundin, 2006) and constitute a leading cause of disability around the world (Ingebrigsten, 2000; Kushner, 1998; McCrea, 2002; Shaw, 2002; van der Naalt, 2001). Resulting from direct contact or acceleration-deceleration forces exerted to the head and neck area (Martin, 2003), TBIs have been typically classified as mild, moderate, or severe based on clinical characteristics pertaining to neurological exam findings, state of consciousness, and post-traumatic amnesia (Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005).

The incidence of TBIs in the entire severity spectrum is approximated at 1.5 to 8 million cases per year in the United States (Kushner, 1998; McCrea, 2002). Canadian statistics drawn from hospital settings also reveal a significant incidence, with estimates ranging from 100 to 300 cases per 100 000 people yearly (Cassidy, 2004a; Guidelines for Planning Brain Injury Services and Supports in British Columbia, 2002). However, as it is well known that a large proportion of people who sustain a head injury will not seek medical attention, Canadian incidence is estimated as high as 600/100 000 cases per year (Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005).
Direct and indirect costs of TBIs are approximately 3 billion dollars annually. Of these TBIs, an overwhelming majority is classified as mild traumatic brain injuries (MTBI), accounting for 75 to 90% of all TBI cases (Cassidy, 2004a; Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005). This milder category of brain injuries constitutes the focus of this study. The next section offers a definition of MTBI and presents its epidemiological attributes in the general population.

Mild Traumatic Brain Injuries: Definition and Epidemiology

To date, various criteria have been utilized to define MTBI (de Kruijk, 2001; Gomez, 1996; Kushner, 1998), and thus, no universal definition currently exists. Indeed, while some authorities include clinical signs indicative of a localized cerebral lesion, radiological findings confirming a cerebral lesion or cranial fracture, as well as the need for a neurosurgical intervention as MTBI diagnostic criteria, others consider such markers as exclusion criteria (de Kruijk, 2001; Esselman, 1995; Kushner, 1998; Peloso, 2004). Despite diagnostic criteria disparities, current literature suggests that MTBI diagnosis is generally made based on widely accepted clinical characteristics, which include loss of consciousness, post traumatic amnesia, and Glasgow coma scale (Martin, 2003).

For the purpose of this study, MTBI diagnosis was defined based on the following Task Force criteria:
- Alteration or loss of consciousness: 0 to 30 minutes duration;
- GCS obtained in ED or within 30 minutes following the head trauma: score of 13 to 15;
- Brain imaging lesions (fracture of intracranial injury): present or absent;
- Neurological exam: possible positive findings;
- Post traumatic amnesia: variable, but always objectified within \( \leq 24 \) hours of head trauma.

These clinical manifestations of MTBI must not be due to alcohol intoxication, illicit drug use or medications, secondary to other injuries or to the treatment of other injuries (facial or systemic lesions, intubation), caused by other concomitant problems (psychological trauma, language barrier, or other coexisting pathologies), or secondary to a penetrating head trauma (Cassidy, 2004a).

The Task Force study findings suggest that MTBI is higher among 18 to 23 year olds, its incidence being nearly 4 times greater than in other age groups (Cassidy, 2004a). Furthermore, men are twice as likely to sustain a MTBI than women. The mechanisms of injury leading to mild brain injuries vary according to age groups, motor vehicle accidents and accidental falls being most frequently reported in young adult and elderly populations, respectively, and accounting for 20% to 60% of all MTBI, according to age groups ( Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005; The Economic Burden of Unintentional Injury in Ontario, 1999). Sports and leisure
activities are also a common cause of MTBI in both pediatric and adult populations (Cassidy, 2004a). Preventative measures to reduce the incidence of TBI as well as the severity of such head injuries include the obligatory use of a helmet by both cyclists and motorcyclists, which has been estimated to reduce to risk of sustaining a TBI by half (Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005). Automobile seatbelts and appropriate for age children seats have also shown to decrease both morbidity and mortality TBI rates. Lastly, alcohol intoxication is frequently associated with devastating TBI outcomes, and thus, measures to raise societal awareness and programs to prevent driving under the influence are continuously being invested in (Orientations Ministérielles Traumatisme Craniocérébral Léger, 2005). The next section focuses on the natural clinical history that follows a MTBI.

Clinical History following MTBI: Post Concussion Symptoms, Post Concussion Syndrome, and Pain Reports

Post Concussion Symptoms. A constellation of symptoms is typically reported in the acute phase (within days) following a MTBI. These symptoms are generally categorized as physical, psychological, or neurocognitive in nature (Cassidy, 2004a; Cushman, 2001; McHugh, 2006; Rapoport, 2002; Vos, 2002; Yang, 2007). Common physical symptoms include headaches, fatigue, nausea, and sleep disturbances. Feeling irritable, depressed, or impatient are typical psychological
complaints reported. Neurocognitive symptoms, for their part, usually manifest as forgetfulness, slowing of thought process, as well as impaired ability to concentrate. The presence and severity of these post-concussion symptoms are widely clinically assessed using the psychometrically sound Rivermead Post Concussion Symptoms questionnaire (RPQ) (King, 1995).

Previous studies suggest that up to 80% of patients present at least one symptom in the acute period, and close to 50% of patients report one or more persisting symptom(s) at 3 months following MTBI (Alves, 1993; Binder, 1997; Mulhern, 2006). Although physical symptoms are typically reported in the acute phase post injury, discrepancies remain regarding the nature and prevalence of symptoms post-MTBI (Chambers, 1996; Kraus, 2005; Lundin, 2006).

More specifically, Chambers et al. (1996) reported that complaints of fatigue, sleep disturbances, and mood alterations were reported in nearly 40% of patients within 1-3 months following MTBI, while other studies reveal a prevalence ranging from 25% to 40% for headaches, sleep disturbances, and fatigue for the same post-injury timeframe (Chaput, 2009; Stulemeijer, 2006a). While the resolution of these various symptoms usually occurs within 1-3 months (Carroll, 2004a; Ponsford, 2000), patient reports of persisting neurocognitive and psychological symptoms months to years following the MTBI remains a significant problem, as they can result in functional disability and adverse clinical outcomes (Boake, 2004; Deb, 1998; Ponsford, 2000;
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Rutherford, 1979). Previous studies have shown that such symptoms may afflict patients for lengthy periods of time, as long as 12 to 36 months post-injury (Heitger, 2006; Ingebrigtsen, 1999; Nolin, 2006). This cluster of persistent neuro-psychological symptoms has been described as the post concussion syndrome (PCS) (WHO, 1978). The next paragraphs are dedicated to presenting this controversial syndrome and its associated complexities.

Post Concussion Syndrome. To date, post concussion syndrome (PCS) has received an ample quantity of definitions, yet no current description has been universally agreed upon (Carr, 2007). The World Health Organization (WHO), for example, has defined PCS as a syndrome that occurs following a head trauma and includes three (or more) of the following persisting symptoms: headache, dizziness, fatigue, irritability, difficulty in concentration and in performing mental tasks, impairment of memory, insomnia, reduced tolerance to stress, emotional excitement or alcohol consumption (WHO, 1978). Other PCS descriptions have been put forward with their respective diagnostic criteria, such as the American Psychiatric Association (Diagnostic and Statistical Manual of Mental Disorders, 2000). This absence of authoritative definition makes PCS the ongoing subject of heated scientific debate as to its validity as a distinct syndrome (Lees-Haley, 2001; Mickeviciene, 2004; Satz, 1999). Additionally, the etiology of PCS remains controversial, as despite numerous reports suggesting causal
factors leading to its development, such as biological effects of the injury, physical, psychological, and/or psychosocial factors, or a combination of these, (Brown, 1994; Cicerone, 1995; Mittenberg, 2000; Youngjohn, 1995), its pathogenesis is still poorly understood (Iverson, 2005). As a result of these aforementioned challenges, considerable discrepancies of prevalence rates is noted between studies (Carr, 2007). Indeed, prevalence rates of PCS ranging from 7 to 90% are reported in the literature, based on various timeframes post MTBI (3 months to 1 year following head injury) (Hall Ryan CW, 2005; Legome, 2006).

In turn, the identification of predictors of post concussion syndrome has thus far proven to be a tedious task. While some consistent findings have indicated a strong association between compensation and/or litigation issues and prolonged disability and post concussion syndrome (Binder, 1996; Cassidy, 2004b; Miller, 2001; Paniak, 2002, 2000), other scientific reports have seemingly further contributed to the perplexity surrounding this syndrome by providing evidence of contradictory findings (de Broussard, 2005; Hoffman, 2002; Savola, 2004).

More specifically, while some studies have reported organic factors such as protein S100B levels as a predictor of MTBI outcome (Pelinka, 2003; Savola, 2004), others have refuted such findings (de Broussard, 2005). Moreover, an extensive literature on neuropsychological factors associated with PCS exists, including
attention difficulties (Bohnen, 1992a; Chan, 2002), impaired processing speed (Cicerone, 2002), and altered working memory (Chen, 2003), to cite just a few. Despite these findings, whether neuropsychological impairments is a cause or consequence of PCS remains undetermined (Carr, 2007). Lastly, psychological factors such as anxiety, depression, and post-traumatic stress reactions (King, 1996; Meares, 2006), as well as pre-injury psychiatric disorders (Fann, 2004, 2002), have also been brought to light as predictors of PCS development. Studies have also proposed that a patient’s personal beliefs and perceptions of an injury might predispose them to PCS (Mittenberg, 1992; Whittaker, 2007), but more confirmatory investigations are required to ascertain this. Thus, these contradictory findings, along with the absence of confirmatory investigations, continue to feed the misunderstanding of PCS and its predictors.

Furthermore, having been identified in patients afflicted with medical conditions other than head injuries, as well as in healthy populations (Iverson, 2006; Mittenberg, 1992; Rutherford, 1979), post-concussion symptoms appear nonspecific to the traumatic brain injury population, which further contributes to the controversy surrounding its recognition as a syndrome distinctive to traumatic brain injury populations (Lees-Haley, 2001; Mickeviciene, 2004; Rutherford, 1979). Thus, factors contributing to the development of persistent physical, psychological, and cognitive symptoms following a MTBI, regardless of their recognized entity as a syndrome or not, remain poorly understood.
Nonetheless, given the current evidence detailed above, and potential benefits of cognitive-behavioral and psychological interventions in reducing PCS (Ponsford, 2002; Wade, 1998), this complex “syndrome” merits additional investigative efforts, as these might lead to an improved capability to predict MTBI outcome (Perel, 2006; Stulemeijer, 2008). The next paragraphs discuss another facet that shapes the clinical history following a MTBI: the component of pain reports.

Pain following Mild Traumatic Brain Injury. Pain is a significant problem following a TBI, and more particularly after a milder traumatic brain injury (Martelli, 2002; Merskey, 1994). Indeed, in a recent review of literature, a compilation of previous study findings suggested that prevalence of chronic pain was greater in MTBI patients in comparison to moderate and severe TBI patients (Nampiaparampil, 2008). A wide array of factors has been proposed to explain the greater pain experience in MTBI in comparison to more severe brain injuries. The length of healing process has been proposed as one of these factors, in that the physical healing process in milder head injuries may be impeded by an earlier return to regular activity, as opposed to more severe TBI cases, which may encourage healing to take its course because prolonged periods of immobilization are usually required (Zasler, In press).

Other proposed factors pertain to clinical characteristics, such as loss of consciousness and post-traumatic amnesia. More specifically,
research findings have suggested that awareness and pain perception processes are less likely to be affected in MTBIs, as loss of consciousness and post-traumatic amnesia are less severe or clinically absent in these cases. This increased vigilance and physiological arousal may thus contribute in the exacerbation of the pain experience (Martelli, 2004). While nociceptive stimulation (i.e. a stimulation causing pain) cannot be disregarded, its contribution to the pain experience appears less than that of the neurological system, which comprises cognitive, motivational-affective, sensory-discriminative, as well as motor and social spheres (Melzack, 2001).

Furthermore, it has long been known that the pain experience is influenced by numerous factors other than the nociceptive stimulation, such as components pertaining to the perception field, including personal beliefs, emotions, as well as coping traits and mechanisms. Pain that does not subside as anticipated during the healing process aggravates the constellation of post concussion symptoms following MTBI, and contributes to the presence and/or persistence of these symptoms (Martelli, 2004). The evolution of pain from an acute to chronic state following a TBI is not uncommon, as studies have reported chronic pain prevalence ranging anywhere from 37% to 70% in the following 3 months to 2 years after a brain injury (Beetar, 1996; Lahz, 1996; Mooney, 2005; Uomoto, 1993). The progression of pain to a chronic state leads to considerable emotional and behavioral changes, which can significantly impair a patient’s life. To date, the clinical
assessment and effective management of pain remains a tremendous healthcare challenge. Given the exorbitant consequences associated with persisting pain, in terms of both patient quality of life and economic healthcare costs, more methodologically sound studies are warranted. The following section delineates the factors influencing MTBI outcome.

Factors Influencing Mild Traumatic Brain Injury Outcome

Over the past decades, considerable scientific efforts have been made to identify and gain a greater understanding of factors influencing MTBI outcome. Indeed, an impressive quantity of studies has been published in recent years, describing the development of early symptoms (Savola, 2003; Stulemeijer, 2008), presence of concomitant extracranial injuries (Stulemeijer, 2006b), post-traumatic level of physical functioning (pain, fatigue) (Lundin, 2006), as well as psychological status such as depressed mood (Yang, 2007), as factors adversely influencing MTBI outcome. Moreover, higher levels of education, in relation to return to work, have been found to predict more favorable outcomes following milder head injuries (Boake, 2005; Ruffolo, 1999).

Despite this growing literature, whether certain elements contribute to MTBI outcome or not remains unclear, as reports have shown contradictory results for age, gender, and previous history of mental health issues, for example (Cattelani, 1996; Ponsford, 2000; Savola, 2003; Stulemeijer, 2008). Such conclusive differences have
been attributed to various research methodological weaknesses: absence of comparison group, variability in inclusion/exclusion criteria and patient recruitment techniques, inadequate study sample size, as well as outcome measurement disparities (Kraus, 2009). Thus, although substantial progress has been made in this field, further investigations, and particularly prospective and longitudinal studies, are needed to not only entirely grasp the multitude of facets that shape the clinical evolution following a MTBI, but also to accordingly improve the existing management and treatment of patients who sustain such a head injury.

Section Summary

This first review of literature section presented a definition of MTBI based on the Task Force criteria, and summarized its epidemiological attributes. The natural clinical history of MTBI, including post-concussion symptoms, post-concussion syndrome, and pain reports were also outlined. The clinical relevance for further investigations to better comprehend the factors that predict MTBI outcome was stressed. The next segment of this review will introduce the concept of pain catastrophizing as a cognitive coping process, and describe its potential adverse impact on various clinical outcomes, including MTBI.
Section 2 - Pain Catastrophizing

Overview of Pain Catastrophizing

In recent years, psychological factors have been recognized as weighty contributors of the pain experience (Leventhal, 1979; Quartana, 2009; Turk, 1992). Indeed, a shift in focus has been noted, as determinants other than physiological factors have been identified as mediators of the pain experience (Quartana, 2009; Turk, 1992). Pain catastrophizing, amongst others, has emerged as one of these influential determinants (Keefe, 1989, 1987; Sullivan, 1995). The following section further details the concept of pain catastrophizing, outlining its historical origins.

Historical Review of Pain Catastrophizing

In the past decades, given the substantial evidence emphasizing the contribution of catastrophizing in the pain experience, the concept of pain catastrophizing and its components has evolved expediently. The focus of Chaves and Brown’s early work in assessing catastrophizing was based on magnification, negative expectations, as well as memories of past pain experiences (Chaves, 1987). Other researchers highlighted self-reports of worry and excessive focus on the negative aspects of the pain experience as a dimension of catastrophizing, in which a person has an inability to divert attention away from pain (Spanos, 1979). Later studies proposed helplessness and inability to
cope effectively with pain as core components of catastrophizing, and
designed the Coping strategies questionnaire (CSQ) as a self-report
instrument aiming at assessing catastrophizing tendencies (Rosentiel, 1983). From this latter instrument emerged the Pain Catastrophizing
(PC) scale, developed by Sullivan and colleagues (Sullivan, 1995),
which was found to be a psychometrically sound instrument to evaluate
pain catastrophizing, and notably contributed to further defining the
concept of pain catastrophizing.

This next section offers a thorough definition of catastrophizing
as a coping thought process, and details its 3 dimensions: rumination,
magnification, and helplessness. Evidence suggesting that the
appraisal process of coping is related to the 3 dimensions of pain
catastrophizing will then be outlined. Lastly, evidence demonstrating
the impact of pain catastrophizing on clinical outcomes will be put
forward.

Pain Catastrophizing: Definition and Theoretical Perspectives

Pain catastrophizing, which can be broadly defined as an
exaggerated appraisal of the negative components of an actual or
anticipated pain experience (Sullivan, 2001; Turk, 1996), is
characterized by 3 catastrophizing dimensions: rumination,
magnification, and helplessness (Sullivan, 2001). Based on the PC
scale, rumination refers to rumination thoughts, worry, and an inability to
inhibit pain-related thoughts. Magnification describes an excessive
focus of the negative aspects of a pain experience and expectancies for a negative outcome. Helplessness refers to the inability to effectively cope with a pain experience (Drahovzal, 2006; Sullivan, 1995, 2001). As the CSQ assesses solely the helplessness dimension, the PC scale is considered a broader and more complete evaluation of the pain catastrophizing construct (Quartana, 2009).

A myriad of factors have been shown to influence psychological outcome following a TBI, including occupational status (Bowen, 1998), and social support (Pelletier, 2000). Coping strategies adopted by patients who sustain a TBI also appear to shape emotional adjustment (Anson, 2006; Curran, 2000; Finset, 2000). Indeed, coping, which can be defined as constantly changing cognitive and behavioral efforts to manage specific internal and external demands that are appraised as taxing or exceeding the resources of the individual (Lazarus, 1984), has been shown to contribute to the clinical outcome of TBIs. The appraisal process of coping, which constitutes an assessment of such demands from which coping strategies will be adopted (Quartana, 2009), is part of the transactional model of stress and coping suggested by Lazarus (Lazarus, 1984). This appraisal process is categorized into primary and secondary appraisals (Lazarus, 1984).

Primary appraisal refers to how a potential stressor is perceived—i.e. benign or harmful. Personal values, beliefs, and goals about oneself contribute to defining a stressor as a threat or not to well-being (Folkman, 1986). Secondary appraisal consists in the coping
mechanisms believed to be available to deal with a stressor, and whether such mechanisms will be useful or not. The person assesses the various coping mechanisms to be potentially utilized, such as actions to modify the stressor, seeking support from outside resources, or acceptance of the stressor’s occurrence, for example (Folkman, 1986).

Study findings indicate that this appraisal process of coping might be associated with the 3 dimensions of pain catastrophizing (Severeijns, 2004), and thus, contribute to shaping the pain experience. More specifically, researchers have proposed that rumination and magnification cognitive processes might result in the excessive focus and extremely harmful perception of a pain experience (primary appraisal), while the perceived inability to cope with such pain experience (secondary appraisal) might reflect the helplessness dimension of pain catastrophizing (Severeijns, 2004). In turn, this maladaptive, catastrophizing-type of appraisal, and its ensuing adopted coping strategies can adversely impact the recovery process and overall outcome of various clinical entities. The section that follows will present evidence demonstrating the deleterious contribution of pain catastrophizing not only on the pain experience, but also in numerous medical conditions and clinical settings.
Impact of Pain Catastrophizing on Clinical Outcomes

Literature findings have been consistent in demonstrating the relationship between heightened pain and catastrophizing in both healthy asymptomatic individuals (Sullivan, 1995, 1997, 2001), as well as in various clinical settings including arthritis and other rheumatic disease (Edwards, 2006), surgical procedures (Jacobsen, 1996), low back pain (Flor, 1993; Severeijns, 2001), and burn dressing changes (Haythornthwaite, 2001), to name a few. Moreover, previous investigations have shown that assessment of catastrophizing tendencies in the absence of pain predicted later pain ratings during experimental pain inducing stimulation (Sullivan, 1995, 1999). Catastrophizing also proved to be a predictor of pain ratings in clinical settings, such as in a group of patients afflicted with arthritis (Keefe, 1989).

Furthermore, an impressive literature has described the relationship between catastrophizing and pain and illness behaviors (Sullivan, 2001). Pain behavior consists in the verbal and motor responses secondary to experiencing pain (Fordyce, 1976). Illness behavior refers to pain behaviors in which a person exhibits excessive concern toward the management of a given symptomatology, or adopts help-seeking behaviors (Sullivan, 2001). To date, numerous studies have shown that the relationship between catastrophizing and illness behaviors has weighty repercussions on healthcare resources. More specifically, catastrophizing has been associated with frequency of visits
to healthcare professionals and hospital stays (Gil, 1992, 1993), as well as use of both hospital administered and over-the-counter primary medications (Flor, 1993; Jacobsen, 1996).

Lastly, catastrophizing has been associated with disability in various clinical settings (Sullivan, 2001). Disability has been defined as any restriction or inability to complete an activity secondarily to physical or mental impairments (Feuerstein, 1989). Over the years, various indices have been utilized to assess disability, such as level of functionality, daily household chores completion, or engagement in occupational and social activities, for instance (Kerns, 1985; Sullivan, 2001). Examples illustrating the deleterious relationship of catastrophizing and disability include groups of patients with whiplash (Sullivan, 2002), soft-tissue injuries (Sullivan, 1998), fibromyalgia (Martin, 1996), rheumatoid arthritis (Parker, 1989), and low back pain (Vienneau, 1999).

Thus, even upon controlling for confounding factors such as depression, anxiety, severity of disease (Martin, 1996), pain severity (Sullivan, 1998), compensation status and illness duration (Keefe, 1989), given the deleterious impact of catastrophizing on the course of various disease entities and its association with increased disability, further clinical investigations are warranted to better comprehend how to minimize or prevent its adverse consequences.
Section Summary

This second section of the literature review presented a thorough definition of the concept of pain catastrophizing, including its historical origins and underlying psychological origins in terms of the appraisal process of coping. Evidence demonstrating how catastrophizing adversely contributes to the experience of pain and disability were discussed. Lastly, the imperative need for further investigations to fully elucidate the role of pain catastrophizing in patient wellbeing and clinical course was stressed. The next chapter presents the aims of this study, along with its research hypotheses.
CHAPTER 3 – STUDY AIMS AND RESEARCH HYPOTHESES

Study Aims

The main goal of this study was to assess whether pain catastrophizing (PC) contributes to early adverse outcomes following a MTBI. For the purpose of this project, MTBI outcome was examined in terms of pain severity and post concussion symptom reports, psychological distress, level of daily functionality following MTBI, and as the potential development of post concussion syndrome.

More specifically, the aims of this study were five-fold: first, to assess if PC predicts the severity of pain reported by patients who sustain a MTBI; second, to evaluate if PC influences subjective post concussion symptoms reports; third, to examine the relationship, if any, between PC and psychological distress following a MTBI; fourth, to determine whether there is a relationship between PC and level of functionality following MTBI, and last, to assess if PC is a risk factor for the development of post concussion syndrome.

Research Hypotheses

It was hypothesized that in the early clinical stage following a MTBI (1 month post head trauma), pain catastrophizing would be:
Brain Injury and Pain Catastrophizing

- associated with greater severity of self-reported pain, including both headache pain and general pain;
- related with greater reports of post concussion symptoms;
- linked to increased psychological distress;
- associated with a decreased level of daily functionality, and;
- a risk factor for the development of post concussion syndrome (PCS).
CHAPTER 4 - METHODOLOGY

Description of Study

The study was conducted at Hôpital du Sacré-Coeur de Montréal, an accredited specialized trauma center (CCASS). A prospective descriptive design was utilized to evaluate pain catastrophizing tendencies in relation to clinical outcome of patients who sustained a MTBI. All patients seen at the Emergency Department (ED), and diagnosed with a MTBI were eligible to participate. Hospital ethics approval was granted for this study. A minimal monetary compensation was awarded to each participant. This study was part of a larger scale study involving a research protocol assessing sleep and pain variables, followed by a blood collection to determine participants’ genotype.

Clinical Characteristics, Inclusion and Exclusion Criteria

MTBI diagnosis was established by a certified neurosurgeon based on the following Task Force criteria: state of consciousness, post-traumatic amnesia, and scoring of Glasgow coma scale (GCS) (Carroll, 2004a; Holm, 2005) (See Review of Literature section for specifics of MTBI diagnosis). Inclusion criteria consisted of any patient seen at the hospital for a day or more, and for which post-trauma symptoms were not due to alcohol intoxication, illegal substance or medication, or caused by other injuries (systemic or facial lesions, intubations). Exclusion criteria included age < 18 years, language barrier, known
history of mental retardation, previous diagnosis of dementia or learning
disability impairing the patient’s cognitive and reasoning processes, or
current co-existing neurological or psychiatric illness.

Participant Recruitment

Recruitment of study participants was performed by a trauma research nurse between the periods of January 2006 to August 2010. All head injury patients seen at the ED of the hospital and diagnosed with an MTBI were eligible to participate. Written consent, which detailed the voluntary basis and specifics of the research protocol, was obtained for each patient enrolled in the study (See appendix for consent form details). Of all eligible patients during the timeframe specified above, 80 consented to participate in this study. However, following a meticulous review of all participants recruited, a total of 22 were excluded from the study because they did not meet the inclusion criteria, voluntarily withdrew from the research protocol, or there was incomplete study data. The final sample size consisted of 58 participants. Details of participant recruitment are illustrated below:
Total patients seen in ED and diagnosed with MTBI (n=2733)

Recruited for study participation (n=128)

Refused to participate (n=48)

Consented to participate (n=80)

Excluded from study (n=21)

Voluntarily withdrew (n=1)

Did not meet study criteria (n=9)

Reasons for exclusions:
- No MTBI diagnosis (n=3)
- History sleep apnea (n=2)
- History alcohol-induced pancreatitis (n=1)
- History of TBI (n=1)
- Current depression (n=2)

Total number of participants (n=58)

Did not complete/incomplete study data (n=12)
Data Collection Procedure

Medical Chart Review. Medical charts were thoroughly reviewed in order to collect the patient-related characteristics listed below: previous medical and surgical history, with systematic search of the targeted following illnesses: sleep disturbances, chronic fatigue syndrome, psychiatric illness or neurological impairment, and previous history of traumatic brain injury. Current medication intake, habits (smoking, alcohol, and drug use), as well as known allergies were also recorded.

Data pertaining to the traumatic injury leading to the MTBI, as well as medical and/or surgical management and treatment received during the hospital stay, were also gathered from the patients’ medical charts.

Clinical Assessment Instruments. In addition to data drawn from patient medical charts, participants filled out a set of self-report questionnaires, which included the 3 instruments utilized to collect data related to the variables of interest in this study (subjective reports of pain severity and post concussion symptoms, psychological distress, level of functionality, post concussion syndrome development, as well as pain catastrophizing tendencies). These instruments included the following validated questionnaires: the Rivermead Post Concussion Symptoms Questionnaire (RPQ) (King, 1995), the Multidimensional Pain Inventory (MPI) (Kerns, 1985), and the Pain Catastrophizing (PC) Scale.
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(Sullivan, 1995). Participants completed these questionnaires at home within 6-8 weeks following their MTBI diagnosis, under these specific instructions:

- no help from significant other, family member, or other individual during questionnaire completion;
- completion of questionnaires to be done in a quiet environment, free of visual and noise disturbances.

A self-addressed and pre-stamped envelope was provided to each participant, and completed questionnaires were returned to the hospital by mail for later data extraction and analysis. These 3 clinical tools are further described in the paragraphs that follow.

Rivermead Post Concussion Symptoms Questionnaire (RPQ)

The RPQ, a standardized survey previously shown to be a reliable symptom measure across the entire range of severity of traumatic brain injuries (King, 1995), was utilized for post concussion symptoms assessment. To date, the RPQ was been widely used to describe the effects of an MTBI and has been validated post injury (Eyres, 2005). Consisting of a 16 post-concussion item list, patients rate the degree to which the PCS are more of a problem in comparison to pre-morbid levels, using a Likert-type scale of 0 to 4 (not experienced at all to severe) (King, 1995; Kraus, 2009). Targeted somatic, affective and cognitive complaints of the RPQ are the following: headaches, dizziness, nausea, noise sensitivity, sleep disturbance, fatigue,
irritability, feeling depressed, frustration/impatience, forgetfulness, poor concentration, taking longer to think, blurred vision, light sensitivity, double vision, and restlessness (King, 1995). While the original version of the RPQ was designed in the English language, an adapted French version of the RPQ was utilized in this study (See appendix).

RPQ completion was performed at 2 timeframes following MTBI. The first RPQ was administered by a trauma research nurse at 33 days post-MTBI (x = 33 days). The second RPQ was completed in the self-reported fashion described above at 55 days post-MTBI (x = 55 days). Timeframe 1 was defined as 1 month (Response rate: 96.6%), and timeframe 2 as 8 weeks (Rate response: 82.8%) following MTBI, respectively.

Multidimensional Pain Inventory (MPI)

The Multidimensional Pain Inventory Scale (MPI) was designed to assess the behavioral, cognitive, and emotional aspects of patients living with pain (Kerns, 1985). It consists in a 3 sections questionnaire, which evaluates how pain impacts the overall life spheres of an individual. Section 1 assesses the individual’s pain experience under 5 subcategories: pain interference, support, pain severity, life control, and affective distress. Section 2 evaluates the individual's perceived support received from a significant other. Section 3 assesses the individual’s level of functionality with regards to completion of daily activities.
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(household-related chores and social activities) (Kerns, 1985). The MPI has proved to be a reliable and valid pain assessment tool (Kerns, 1985), and has been utilized to evaluate pain in various clinical conditions, including cancer (Zaza, 2000), as well as whiplash-associated disorder (Olsson, 2002). Originally constructed and validated in English, the MPI has since been translated and validated in other languages, including in French (Laliberte, 2008). This latest French version, “L’inventaire Multidimensionnel de la Douleur”, was utilized in this study (See appendix). This instrument was utilized to assess pain catastrophizing in relation to psychological distress and level of functionality.

Pain Catastrophizing (PC) Scale

The PC Scale (Sullivan, 1995) is a self-report assessment that was designed to measure catastrophizing by gathering previously emphasized catastrophizing items in the literature (Chaves, 1987; Rosentiel, 1983; Spanos, 1979). It comprises a total of 13 catastrophizing thoughts or feelings items to be rated by the individual using a Likert-type scale from 0 to 4 (“not at all” to “all the time”) (Sullivan, 1995). These catastrophizing items are further divided into 3 dimensions encompassing catastrophizing: magnification, rumination, and helplessness (Sullivan, 2001). This 3-dimensional structure of catastrophizing has been replicated in other studies (Osman, 2000). The PSC has been shown to be a reliable and valid clinical instrument to
measure catastrophizing (Sullivan, 1995), including its French version (French, 2005). This latter version was utilized in this study to assess catastrophizing thinking in relation to severity of pain and post-concussion symptom reports.

Statistical Analysis

Data analysis included descriptive statistics, Pearson’s correlations ($r$), as well as Student $t$-tests. Statistical significance was defined as $p < .05$. 
CHAPTER 5 - RESULTS

The following research findings chapter contains 6 sections. Section 1 is reserved for descriptive statistical results, in which study population, clinical characteristics, and subjective pain and post-concussion symptoms prevalence are presented. Sections 2, 3, 4, 5, and 6 reveal findings pertaining to study aims 1, 2, 3, 4 and 5, respectively.

Section 1 - Descriptive Statistical Findings

Study Population Characteristics

Study sample included a total of 58 participants for which gender and age distributions were as follows: 72.4% males and 27.6% females, with a mean age of 39.6 years (min. age: 19-max. age: 63).

Socio demographic data revealed participants’ marital status as single, married, common-law, and divorced or separated in 31%, 29.3%, 24.1%, and 15.5% of cases, respectively. Most participants reported working on a full-time basis at the time of the head injury (75.9%), earning a net family income between $25 000 and $50 000 (34.5%), and having completed some or all high school level of education (37.9%).

41.4% of participants had a previous medical history prior to the sustained MTBI, hypertension (13.8%), dyslipidemias (8.6%), and diabetes (6.9%) being the most frequent diagnoses. Current medication(s) usage as well as smoking, alcohol, and drug intake habits
were also recorded for each patient. Study population characteristics are further detailed below in Table 1:

Table 1.

*Study Population Characteristics*

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Frequency (N=58)</th>
<th>Total Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time work</td>
<td>44</td>
<td>75.9</td>
</tr>
<tr>
<td>Part-time work</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>Unemployed/Searching for job</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>Full-time school</td>
<td>5</td>
<td>8.6</td>
</tr>
<tr>
<td>Retired</td>
<td>3</td>
<td>5.1</td>
</tr>
<tr>
<td>Seasonal work</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>Full-time school and part-time job</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>22</td>
<td>37.9</td>
</tr>
<tr>
<td>College</td>
<td>14</td>
<td>24.2</td>
</tr>
<tr>
<td>University</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Other (vocational training)</td>
<td>3</td>
<td>5.2</td>
</tr>
<tr>
<td>Unknown/Unspecified</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Net Family Income ($)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 000</td>
<td>8</td>
<td>13.8</td>
</tr>
<tr>
<td>25 000-50 000</td>
<td>20</td>
<td>34.5</td>
</tr>
<tr>
<td>50 001-75 000</td>
<td>8</td>
<td>13.8</td>
</tr>
<tr>
<td>75 001-100 000</td>
<td>9</td>
<td>15.5</td>
</tr>
<tr>
<td>&gt;100 000</td>
<td>10</td>
<td>17.2</td>
</tr>
<tr>
<td>Unknown/unspecified</td>
<td>3</td>
<td>5.2</td>
</tr>
</tbody>
</table>
Clinical Characteristics Related to the MTBI

Clinical history of amnesia, loss of consciousness, and Glasgow coma scores (GCS) post head injury revealed the following: amnesia and loss of consciousness were confirmed in 17.2% and 65.5% of cases, respectively, while the presence of these clinical signs was unascertained in 5.2% and 12.1% of cases, respectively. Mean GCS recorded at initial patient evaluation (at scene of trauma) and at ED assessment at our hospital were 13.9/15, and 14.5/15, respectively. Mean length of stay at hospital was 3.88 days (min. days: 1-max. days: 25).

The most frequent mechanisms on injury were motor vehicle accidents (patient driver) and accidental falls in 34.5% and 25.9% of cases, respectively (See Table 2: Mechanisms of Injury). Of all head injury cases, 17.2% of these occurred in the participants’ work setting. Furthermore, alcohol intoxication was confirmed or clinically suspected in 7 of all cases (12.3%).
Table 2.

*Mechanisms of Injury*

<table>
<thead>
<tr>
<th>Description of Mechanism</th>
<th>Frequency (N = 58)</th>
<th>Total Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle accident (MVA)</td>
<td>20</td>
<td>34.5</td>
</tr>
<tr>
<td>Accidental fall</td>
<td>15</td>
<td>25.9</td>
</tr>
<tr>
<td>Cyclist hit by car</td>
<td>5</td>
<td>8.6</td>
</tr>
<tr>
<td>Motorcycle accident</td>
<td>4</td>
<td>6.9</td>
</tr>
<tr>
<td>Assault</td>
<td>3</td>
<td>5.3</td>
</tr>
<tr>
<td>Pedestrian hit by car</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>Direct trauma to head</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>Skiing injury</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>Other*</td>
<td>5</td>
<td>8.6</td>
</tr>
</tbody>
</table>

*1 patient per “other” category of mechanism of injury

Concomitant Injuries, Clinical Management and Treatment

While all patients in this study were diagnosed with a MTBI, 36.2% of these revealed to have sustained one or more concomitant injury(ies) other than the head trauma itself. More specifically, 50%, 13.8%, and 19% were also diagnosed with a fracture, contusion, or laceration, respectively. Thoracic/back (69%), and facial (44.8%) were the most common fracture area locations. Pulmonary, myocardial, and thoracic contusions accounted for the majority of contusions recorded, in 7%, 5.2%, and 3.5% of cases, respectively. Sustained lacerations were superficial in nature, and were localized in the head and face areas in the majority of cases (72.7%).
A CT-Scan was performed on 87.7% of patients. Of these, 54.4% revealed abnormal findings, with acute subarachnoid hemorrhage (19.4%), hemorrhagic contusions (16.1%), and punctiform hematoma (12.9%) being the most frequent radiological diagnoses. CT-Scan results were unavailable in 3.5% of cases. While the majority of patients (82.8%) received one or more analgesic(s) during his/her hospital stay, 10.3% of patients received no pain relief medication, while the remainder (6.9%) was undetermined. Table 3 illustrates pain medication data results.

Table 3.

*Pain Medication at Hospital*

<table>
<thead>
<tr>
<th>Analgesic Category</th>
<th>Frequency (N = 58)</th>
<th>Total Patients (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>42</td>
<td>72.4</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>10</td>
<td>17.2</td>
</tr>
<tr>
<td>Natural Opiate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Codeine</td>
<td>10</td>
<td>17.2</td>
</tr>
<tr>
<td>Morphine</td>
<td>13</td>
<td>22.4</td>
</tr>
<tr>
<td>Semi-Synthetic Opiate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>7</td>
<td>12.1</td>
</tr>
<tr>
<td>Full Synthetic Opiate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meperidine/Fentanyl</td>
<td>8</td>
<td>13.8</td>
</tr>
</tbody>
</table>

*Total more than 100% as cumulative data*
Final prognosis was deemed favorable by a multidisciplinary team assessment in 89.5% of all patients, the remainder being classified as unfavorable (3.5%), with a remaining 7% of patients for which the final prognosis was unspecified. Most patients were sent home following their discharge from the hospital (94.7%), with a residual minority whom were transferred to a rehabilitation facility (5.3%).

Subjective Post Concussion Symptoms and Pain Reports

Data analyses drawn from the RPQ revealed that fatigue, sleep disturbances, dizziness, and headaches were the most frequently reported symptoms at 1 month post-MTBI in 70.2%, 66.6%, 52.6%, and 50.9% of participants, respectively. These symptoms remained frequently reported at 8 weeks, as fatigue, sleep disturbances, reduced ability to concentrate, and dizziness afflicted 68.8%, 62.5%, 62.5%, and 60.4% of patients, respectively. Table 4 demonstrates post concussion symptoms prevalence results at 1 month and 8 weeks following MTBI.
### Table 4.

**Prevalence of Post Concussion Symptoms following MTBI**

<table>
<thead>
<tr>
<th>Description of Symptoms (Rivermead questionnaire)</th>
<th>1 month post-MTBI (%)</th>
<th>8 weeks post-MTBI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches</td>
<td>50.9</td>
<td>50</td>
</tr>
<tr>
<td>Dizziness</td>
<td>52.6</td>
<td>60.4</td>
</tr>
<tr>
<td>Nausea</td>
<td>16.1</td>
<td>27.1</td>
</tr>
<tr>
<td>Increased sensitivity to noise</td>
<td>25</td>
<td>31.3</td>
</tr>
<tr>
<td>Sleep disturbances</td>
<td>66.6</td>
<td>62.5</td>
</tr>
<tr>
<td>Fatigue</td>
<td>70.2</td>
<td>68.8</td>
</tr>
<tr>
<td>Irritability</td>
<td>30.4</td>
<td>45.8</td>
</tr>
<tr>
<td>Feeling depressed/teary-eyed</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Feeling impatient</td>
<td>26.8</td>
<td>52.1</td>
</tr>
<tr>
<td>Forgetfulness</td>
<td>48.2</td>
<td>58.3</td>
</tr>
<tr>
<td>Reduced ability to concentrate</td>
<td>50</td>
<td>62.5</td>
</tr>
<tr>
<td>Slowing of thought process</td>
<td>30.4</td>
<td>47.9</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>21.4</td>
<td>22.9</td>
</tr>
<tr>
<td>Increased sensitivity to light</td>
<td>17.9</td>
<td>25</td>
</tr>
<tr>
<td>Double vision</td>
<td>7.1</td>
<td>8.3</td>
</tr>
<tr>
<td>Feeling agitated</td>
<td>5.4</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Data pertaining to self-reported pain was gathered based on the 9 MPI questionnaire pain locations: head and face, cervical region, shoulder and upper limbs, thoracic region, abdominal region, back and coccyx, lower limbs, pelvic region, and perianal/anal/genital areas. Head and face (41.4%), cervical region (37.9%), and back and coccyx
(34.5%) were the most common pain locations. Table 5 shows the prevalence of pain findings.

Table 5.

*Prevalence of Pain following MTBI*

<table>
<thead>
<tr>
<th>Pain location (as per MPI)</th>
<th>Frequency (N = 58)</th>
<th>Total Patients (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and face</td>
<td>24</td>
<td>41.4</td>
</tr>
<tr>
<td>Cervical region</td>
<td>22</td>
<td>37.9</td>
</tr>
<tr>
<td>Shoulder/upper limbs</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Thoracic region</td>
<td>12</td>
<td>20.7</td>
</tr>
<tr>
<td>Abdominal region</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>Back and coccyx</td>
<td>20</td>
<td>34.5</td>
</tr>
<tr>
<td>Lower limbs</td>
<td>10</td>
<td>17.2</td>
</tr>
<tr>
<td>Pelvic region</td>
<td>4</td>
<td>6.9</td>
</tr>
<tr>
<td>Perianal/anal/genital areas</td>
<td>1</td>
<td>1.7</td>
</tr>
</tbody>
</table>

*Total more than 100% as cumulative data*

Section 2 - Study Aim 1 Results

The first aim of this research was to assess if pain catastrophizing predicts the severity of pain reported by patients who sustained a MTBI. In this study, severity of pain reports was defined in two ways: firstly, as headache pain, which was assessed with the “headache” item of the RPQ; and secondly, as general pain, which was evaluated using the MPI Pain Severity scale scores. It was hypothesized that pain catastrophizing would be associated with greater severity of self-reported pain, including both headache pain and general
pain. Pearson’s correlations ($r$) were executed among the PC scales and headache pain severity scores, as well as among the PC scales and MPI Pain Severity scale scores (general pain), respectively. Results are presented below.

**Severity of Headache Pain and Pain Catastrophizing**

At 1 month following MTBI, correlations were found to be positive and statistically significant for both PC Magnification and PC Helplessness subscales (PC Magnification: $r(57)= .329, p < .012$; PC Helplessness: $r(57)= .304, p < .021$), as well as for PC Overall scale ($r(57)= .300, p < .023$), proposing that pain catastrophizing tendencies are associated with greater severity of headache pain reports.

Moreover, at 8 weeks following MTBI, Pearson’s correlation coefficient revealed to be positive and statistically significant for the PC Magnification subscale ($r(48)= .346, p < .016$). These results support our hypothesis, suggesting that pain catastrophizing tendencies contribute to the severity of the headache pain experience, and that over time, magnification thoughts appear to play a central role in the persistent pain experience described by patients who sustain a MTBI.
Severity of General Pain and Pain Catastrophizing

Regarding the general pain variable assessed by the MPI Pain Severity scale scores, results also demonstrated positive and significant correlations for all 3 PC subscales, as well as for PC Overall scale. Table 6 presents these statistical findings:

Table 6.

Correlations amongst Severity of General Pain and Pain Catastrophizing Scores following MTBI

<table>
<thead>
<tr>
<th></th>
<th>General Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC Rumination</td>
<td>.327*</td>
</tr>
<tr>
<td>PC Magnification</td>
<td>.312*</td>
</tr>
<tr>
<td>PC Helplessness</td>
<td>.436*</td>
</tr>
<tr>
<td>PC Overall</td>
<td>.393*</td>
</tr>
</tbody>
</table>

*p < .05

These findings are in agreement with our hypothesis that pain catastrophizing contributes to the severity physical pain reported by MTBI patients.

Section 3 - Study Aim 2 Results

The second aim of this study was to evaluate if PC influences subjective post concussion symptoms reports. Our hypothesis was that PC would be related with greater reports of post concussion symptoms.
Pearson’s correlations ($r$) were conducted among the PC scales and 16 post concussion symptom items of the RPQ data collected at 1 month and 8 weeks post MTBI. As previously described, a self-reported rating of 2, 3, or 4 on the RPQ indicated the presence of the symptom (King, 1995).

Results demonstrated positive and significant correlations for all 3 PC subscales, as well as for PC Overall scale at both 1 month and 8 weeks following MTBI, indicating that PC tendencies are associated with greater post concussion symptom reports, as per our proposed hypothesis. The results of these correlational analyses are presented in Table 7.

Table 7.

**Correlations amongst Sum of Post Concussion Symptoms (PCSx) and Pain Catastrophizing Scores at 1 month and 8 weeks following MTBI**

<table>
<thead>
<tr>
<th></th>
<th>Sum of PCSx at 1 month</th>
<th>Sum of PCSx at 8 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC Rumination</td>
<td>.408*</td>
<td>.368*</td>
</tr>
<tr>
<td>PC Magnification</td>
<td>.353*</td>
<td>.427*</td>
</tr>
<tr>
<td>PC Helplessness</td>
<td>.451*</td>
<td>.400*</td>
</tr>
<tr>
<td>PC Overall</td>
<td>.441*</td>
<td>.422*</td>
</tr>
</tbody>
</table>

*p < .01

**Section 4 - Study Aim 3 Results**

The third aim of this study was to examine the relationship, if any, between PC and psychological distress following a MTBI. Psychological
distress was measured using the MPI Emotional Distress scale scores. It was hypothesized that PC would be associated with increased psychological distress. Pearson’s correlations ($r$) were conducted on the PC scale scores and MPI Emotional Distress scale scores.

Findings indicated a positive and significant correlation for all 3 PC subscales (PC Rumination: $r(55)= .572, p< .000$; PC Magnification: $r(55)= .646, p< .000$; PC Helplessness: $r(55)= .665, p< .000$), as well as for PC Overall scale (PC Score: $r(55)= .664, p< .000$). These results are in agreement with our hypothesis, suggesting that pain catastrophizing tendencies are associated with greater psychological distress following a MTBI.

**Section 5 - Study Aim 4 Results**

The fourth aim of this research was to determine whether there is a relationship between PC and level of daily functionality following MTBI. In this study, level of functionality was assessed utilizing the subscales contained in section 3 of the MPI questionnaire. These subscales examine the level of functionality with regards to completion of daily activities (Kerns, 1985). It was hypothesized that pain catastrophizing would be related to a decreased level of functionality in patients who sustain a MTBI. Pearson’s correlations ($r$) were carried out on the PC scales and MPI Section 3 subscales to verify this hypothesis.
The results of these correlational analyses, which revealed to be negative and significant, are presented in Table 8.

Table 8.

Correlations amongst Level of Functionality (MPI Scales) and Pain Catastrophizing Scores following MTBI

<table>
<thead>
<tr>
<th></th>
<th>PC Rumination</th>
<th>PC Magnification</th>
<th>PC Helplessness</th>
<th>PC Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI Household Chores</td>
<td>-.177</td>
<td>-.273*</td>
<td>-.223</td>
<td>-.228</td>
</tr>
<tr>
<td>MPI Outside Activities</td>
<td>-.238</td>
<td>-.360**</td>
<td>-.292*</td>
<td>-.301*</td>
</tr>
<tr>
<td>MPI Leisure Activities</td>
<td>-.261*</td>
<td>-.379**</td>
<td>-.384**</td>
<td>-.355**</td>
</tr>
<tr>
<td>MPI General Activities</td>
<td>-.288*</td>
<td>-.433**</td>
<td>-.377**</td>
<td>-.374**</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01

These findings indicate that greater pain catastrophizing tendencies are associated with reduced levels of functionality following MTBI, as per our suggested hypothesis.

Section 6 - Study Aim 5 Results

The last aim of this study was to assess if pain catastrophizing is a risk factor for the development of post concussion syndrome. Student t-tests were carried out among the variables of interest in this study, and are further described below.
As an alternative to the previously described post concussion syndrome, conservatively defined as the persistence of 3 symptoms or more following MTBI (WHO, 1978), and its resulting lack of specificity to the TBI population (Kraus, 2009), PCS was given the novel definition of presence of 6 or more symptoms reported on the RPQ for the purpose of this study. A self-reported rating of 2, 3, or 4 on the RPQ indicated presence of the symptom (King, 1995).

Based on the above PCS defining criteria, study participants were categorized into 2 groups: the “At low risk for PCS” group, which comprised patients whom reported 5 symptoms or less on the RPQ, and the “At high risk for PCS” group, which included patients whom reported 6 symptoms or more on the RPQ.

At 1 month following MTBI, the “At high risk for PCS” group had significantly higher scores on all 3 PC subscales in comparison to the “At low risk for PCS” group (PC Rumination: \(t(54)=-3.027, p<.004\); PC Magnification: \(t(54)=-2.242, p<.029\); PC Helplessness: \(t(54)=-2.494, p<.016\)), as well as for PC Overall scale (PC Overall: \(t(54)=-2.828, p<.007\)). Moreover, at 8 weeks post-MTBI, results showed a similar trend, as the PC Magnification subscale score and PC Overall scale were found to be significantly higher for patients in the “At high risk for PCS” group than for patients in the “At low risk for PCS” group (PC Magnification: \(t(46)=-2.233, p<.30\); PC Overall: \(t(46)=-2.003, p<.05\)).
Table 9 reveals the means and standard deviations (SD) for post concussion syndrome risk in relation to PC.

Table 9.

Means and Standard Deviations (SD) for Risk of Post Concussion Syndrome Development in Relation to Pain Catastrophizing

<table>
<thead>
<tr>
<th>PC Scale Scores</th>
<th>Patient Risk Group</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1 month post-MTBI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Rumination</td>
<td>Low risk</td>
<td>3.84</td>
<td>4.30</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>7.63</td>
<td>5.03</td>
</tr>
<tr>
<td>PC Magnification</td>
<td>Low risk</td>
<td>1.91</td>
<td>2.16</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>3.33</td>
<td>2.60</td>
</tr>
<tr>
<td>PC Helplessness</td>
<td>Low risk</td>
<td>3.84</td>
<td>4.25</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>7.29</td>
<td>6.10</td>
</tr>
<tr>
<td>PC Overall</td>
<td>Low risk</td>
<td>9.59</td>
<td>10.10</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>18.25</td>
<td>12.81</td>
</tr>
<tr>
<td><strong>8 weeks post-MTBI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Rumination</td>
<td>Low risk</td>
<td>3.73</td>
<td>4.17</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>6.00</td>
<td>4.55</td>
</tr>
<tr>
<td>PC Magnification</td>
<td>Low risk</td>
<td>1.59</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>2.92</td>
<td>2.12</td>
</tr>
<tr>
<td>PC Helplessness</td>
<td>Low risk</td>
<td>3.68</td>
<td>4.78</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>5.96</td>
<td>4.29</td>
</tr>
<tr>
<td>PC Overall</td>
<td>Low risk</td>
<td>9.00</td>
<td>10.25</td>
</tr>
<tr>
<td></td>
<td>High risk</td>
<td>14.88</td>
<td>10.05</td>
</tr>
</tbody>
</table>
These results support our hypothesis proposing that pain catastrophizing, and more particularly patients whom have a tendency to magnify thoughts (as per PC Magnification subscale findings at 8 weeks), might be more at risk of developing PCS, as these patients report being afflicted with more symptoms post head injury than those whom describe being less symptomatic.
CHAPTER 5 - DISCUSSION

The main objective of this research was to evaluate if pain catastrophizing (PC) contributes to early adverse outcomes following a MTBI. MTBI outcome was examined in terms of pain severity and post concussion symptom reports, psychological distress, level of functionality following MTBI, and as the potential development of post concussion syndrome (PCS).

Our study findings reveal that PC is associated with greater severity of pain (both headache pain and general pain) and post concussion symptom reports in the first 8 weeks following a MTBI. These results suggest that PC adversely contributes to the pain experience in patients who sustain a MTBI, as patients who have PC tendencies report greater pain severity than those whom do not. These findings also imply that PC influences post concussion symptom reports, and consequently, early MTBI outcome. Moreover, our results show that PC tendencies are associated with both an increase in psychological distress, and a reduced level of functionality in the early clinical course that follows a MTBI. Last, when attributing the novel definition of PCS as presence of 6 post concussion symptoms or more, our findings reveal that PC tendencies appear to be associated with a higher risk of PCS development at both 1 month and 8 weeks post-MTBI.
Our results indicating that PC is related to heightened severity of headache and general pain reports following MTBI support the current evidence that catastrophizing is associated with a greater severity of pain experience, as per previously demonstrated in various clinical settings (Flor, 1993; Haythornthwaite, 2001; Jacobsen, 1996; Keefe, 1989). Additionally, our findings reflecting that PC is associated with increased psychological distress in patients who sustain a MTBI are consistent with previously described studies, which have also demonstrated a negative relationship between PC and psychological status (Turner, 2002). These results not only further add to the compelling evidence suggesting that coping strategies, including their cognitive appraisal processes, are related to one’s level of emotional distress (Anson, 2006; Curran, 2000), but also offers promise in improving MTBI outcome. Indeed, given its potential as a predictor of future depression (Keefe, 1989, 1991), early screening and detection of PC tendencies might help identify patients at risk for depression post-MTBI. Consequently, targeted early psychological assessment may prove beneficial in preventing the development of a depression subsequent to a head injury, as this mental disorder has been linked with marked adverse effects on clinical outcome following a MTBI (Yang, 2007).

Furthermore, our results proposing that PC contributes to a decreased level of functionality in the early clinical stage that follows a MTBI are in accordance with extensive prior evidence indicating the
adverse relationship between PC and disability (Keefe, 1989; Martin, 1996; Severeijns, 2001; Sullivan, 1988; Turner, 2002). Lastly, our results suggesting that pain catastrophizing is a risk factor for the development of PCS accordingly follow previous literature findings underlining the weighty contribution of psychological factors in such syndrome development (Carr, 2007). More specifically, studies have reported that patients’ perceptions regarding the believed potential physical and psychological consequences of an injury predicted PCS development (Whittaker, 2007). Thus, strong beliefs that a MTBI will have serious adverse consequences, such as ones emanating from catastrophizing tendencies as shown in our results, appear to be associated with a greater risk of PCS development.

Limitations

A weakness of this study lies in the small sample size, and its ensuing statistical limitations. Indeed, despite thoroughly compiling data pertaining to socio-economic status and work-related versus non work-related head injury, statistical analyses to assess the potential role of these variables as predictors and/or co-factors could not be performed given the modest size of this study population. Such variables, along with financial compensation and litigation factors, have been consistently related with slower recovery processes and unfavorable outcomes post-MTBI (Binder, 1996; Cassidy, 2004b; Paniak, 2002, 2000). Despite this extensive evidence, further confirmatory studies on
these financial factors are imperative (Carroll, 2004b). Moreover, although a systematic review was performed to collect concomitant injuries and pain management-related data in a deliberate attempt to prevent the ascription of injuries and pain control factors to PC cognitive tendencies, here again, this study’s small sample size was not conducive to performing analyses controlling for these variables.

Secondly, as the methodology of this study is mainly correlational in nature, causal conclusions can therefore not be drawn from the presented findings. Moreover, given the statistically significant yet modest correlational findings, caution should be exerted in the interpretation of these results.

Lastly, another limitation consists in the self-reported nature of the clinical data presented. Indeed, regardless of the evidence revealing that most patients can adequately recall numerous problematic experiences (Garske, 1992; Ponsford, 1995), as Carroll and colleagues underlined (2004b), the potential contribution of recall bias or selective differences in post-MTBI symptom reports associated with self-reported data cannot be overlooked. Nevertheless, given its user-friendly, quick and easy to interpret, and low cost qualities, as well as our respectable findings pointing towards the unfavorable effects of pain catastrophizing in MTBI outcome, utilizing the PC scale as a screening tool in the ED might prove worthy. In turn, the early detection of PC tendencies might lead to the implementation of goal-oriented interventions to prevent or minimize the development of chronic post
concussion symptomatology. The necessity for such tailored, case-by-case treatment interventions has been previously reinforced (Godfrey, 1996; Moore, 1994).

Conclusion

Our results suggest that pain catastrophizing tendencies are associated with adverse early clinical outcome in patients who sustain a MTBI. These results also further reinforce previous findings indicating that maladaptive coping strategies are predictors of poor outcomes after a brain injury (Drottning, 1995; Turner, 2002). Moreover, our novel finding suggesting that pain catastrophizing is a risk factor for post-concussion syndrome development is clinically relevant, as it might prove useful in optimizing current management guidelines, such as by introducing early psychological intervention, which has been shown to decrease the PCS incidence (Mittenberg, 1996). These findings show great promise in improving long-term clinical outcomes following a MTBI. Future larger-scale sample research is mandatory to evaluate pain and post-concussion symptom reports, as well as psychological status and level of functionality at 12 months following a MTBI. These future studies will increase the validity of current self-reported assessment findings by including objective assessment techniques such as brain imaging (for anatomical integrity and electrical brain activity assessment), polygraphy (for sleep and autonomic activation data), as well as blood sample collection (for genetic composition evaluation).
Studies comprising these objective techniques, combined with a meticulous examination of the potential determinants of treatment response in patients who have catastrophizing tendencies, are imperative in order to optimize current MTBI management and therapeutic modalities.
References


Brain Injury and Pain Catastrophizing


Gomez, P, Lobato, RD, Ortega, JM, de la Cruz, J. (1996). Mild Head Injury: Differences in Prognosis among Patients with a Glasgow Coma Scale Score of 13 to 15 and Analysis of Factors


Appendix A

Formulaire d’information et de consentement (Consent form)

Centre d’étude du sommeil et des rythmes biologiques
Hôpital du Sacré-Cœur de Montréal
et
Faculté de médecine dentaire, Université de Montréal

- VOLET 2 -

Formulaire d’information et de consentement

**Titre**
Étude prospective pour l’identification de facteurs de risques génétiques chez les sujets ayant subi un traumatisme cérébral léger (TCL) qui favorisent les douleurs chroniques, les troubles de sommeil et les céphalées.

**Vol. 2**
Évaluation, à l’aide de questionnaires et de l’Actigraphie, les niveaux de douleur, de céphalées, de troubles de sommeil et des troubles neuropsychologiques chez le patient TCL.

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Chercheur, Centre de recherche, Hôpital du Sacré-Cœur de Montréal, (514) 343-2310

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**Collaboratrices**
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Isabel Roy, BSc, infirmière Bachelière, Hôpital du Sacré-Cœur de Montréal, (514) 338-2222 poste 3790

**Commanditaires**
Instituts de Recherche en Santé du Canada, Fonds de recherche et Fonds de traumatologie de l’Hôpital du Sacré-Cœur de Montréal.

2005-10-09
Formulaire d'information et de consentement

Nature et objectif de l'étude

Nous vous invitons à participer à titre de sujet à un projet de recherche portant sur le niveau de douleur et la qualité du sommeil des patients ayant subi un trauma crânio-œdèal léger (TCCL) ou bien une blessure orthopédique diagnostiquée par des questionnaires et une montre actigraphique Activwatch. Cette étude se déroule au Centre d'étude du sommeil et des rythmes biologiques de l'Hôpital du Sacré-Cœur en collaboration avec le Centre de Trauma de l'Hôpital du Sacré-Cœur de Montréal. Il est important que vous compreniez certains principes généraux qui s'appliquent à toutes les personnes qui participent à nos études. Cette étude nécessite la participation de 500 sujets présentant un TCCL et de 500 sujets ayant subi une blessure de type orthopédique.

Cette étude a pour but de collecter des données pour mieux comprendre les troubles post-traumatiques afin de mieux cibler les interventions nécessaires. Vous nous ferez remplir des questionnaires sur votre niveau de douleur, la fatigue, le stress, le niveau de vigilance et l'anxiété, vos maux de tête, et votre qualité de vie (90 minutes) et nous vous donnerons une montre actigraphique que vous porterez pour une semaine qui permettra de mesurer la qualité de votre cycle de sommeil.

Un autre volet de cette étude consiste à voir s'il existe un facteur génétique qui pourrait expliquer les douleurs chroniques et les troubles du sommeil après un traumatisme. Pour ce faire, nous procéderons à une prise de sang de laquelle on pourra extraire votre bagage génétique. Cette section fait l'objet d'un volet à part et un autre formulaire de consentement devra être signé pour y participer.

Déroulement de l'étude et méthodes utilisées

Si vous êtes d'accord, vous serez invité(e) à une session de pré-evaluation lors d'un appel téléphonique par notre infirmière qui évaluera votre condition médicale pour déterminer si vous répondez aux critères d'inclusion de notre étude. Si vous correspondez à nos critères de recherche, vous serez invité(e) à poursuivre le projet. On vous demandera alors de remplir seul(e) et au complet, avec la plus de précision possible les questionnaires en hachurant les réponses qui conviennent le mieux à votre situation pour chacune des questions posées. Si vous le désirez, vous pouvez remplir ces questionnaires à la maison et nous les retourner dans les 5 jours qui suivent. De plus, lors de votre visite, nous vous donnerons une montre actigraphique que vous porterez au bras pendant une semaine et qui mesurera vos mouvements durant le jour et la nuit. Lors de ces visites, nous vous donnerons un rendez-vous pour venir nous remettre la montre actigraphique.

Le projet se divise en 2 visites. La première visite se fera 4-6 semaines après votre accident, et la deuxième 12 mois après votre accident. Votre consentement à participer à la présente étude sera confirmé par la signature de ce formulaire. Vous n'avez aucun médicament à prendre et vous ne serez pas hospitalisée.

Risques, effets secondaires et dédommagements

Il n'y a normalement aucun risque prévu pour votre santé. Nous utiliserons les meilleures conditions possibles pour assurer votre sécurité et votre confort. La temps consacré à répondre aux questionnaires pourrait être considéré comme un dédommagement et occasionner de la fatigue.

Bénéfices et avantages

Il est possible que vous ne retirez pas de bénéfices personnels en participant à cette étude. Toutefois, cette étude contribuera à améliorer la compréhension de diverses manifestations post-traumatiques et à aider à mieux les diagnostiquer pour ainsi améliorer la qualité de vie des patients.

Indemnité

Vous ne recevrez pas de dédommagement pour votre participation à chacune des visites mais nous vous rembourserons les frais de stationnement.

apprové par le comité d'éthique de l'Hôpital du Sacré-Cœur de Montréal le 2013-04-08
En cas de préjudice
Si vous deviez subir quelque préjudice que ce soit par suite des procédures reliées à l'étude, vous recevrez tous les soins médicaux nécessaires, sans frais de votre part. En acceptant de participer à cette étude, vous ne renoncez à aucun de vos droits ni ne libérez les chercheurs ou les institutions impliquées de leurs responsabilités légales et professionnelles.

Formulaire d’information et de consentement

Confidentialité

- Tous les renseignements recueillis à votre sujet au cours de l’étude demeureront strictement confidentiels, dans les limites prévues par la Loi, et vous ne serez identifié(e) que par un code. Le code du code relatif à votre nom à votre dossier de recherche sera conservé à l’Hôpital du Sacré-Cœur de Montréal en lieu sûr par le chercheur responsable du projet de recherche pendant 25 ans. Aucune publication ou communication scientifique résultant de cette étude ne renfermera quoi que ce soit qui puisse permettre de vous identifier;
- Le chercheur responsable du projet de recherche et son personnel feront preuve au commanditaire ou à ses représentants, les données collectées du projet de recherche vous concernant. Ces données n’incluent pas votre nom, votre adresse ni aucune autre information révélant directement votre identité.
- Cependant, à des fins de contrôle du projet de recherche, votre dossier pourra être consulté par une personne mandatée par le comité d’éthique de la recherche de l’Hôpital du Sacré-Cœur qui adhère à une politique de stricte confidentialité;
- Votre participation est confidentielle : seul le personnel impliqué dans l’étude aura accès aux dossiers. Nous ne divulguerons aucun résultat à quiconque sauf si la loi nous y oblige;
- La confidentialité sera aussi de rigueur lors de la présentation des résultats de cette étude aux congrès ou dans des journaux scientifiques.

Participation volontaire et retrait de l’étude

- Votre participation est entièrement volontaire, vous êtes donc libre de refuser d’y participer.
- Si vous participez à l’étude, vous êtes libre de vous en retirer à n’importe quel moment, sans avoir à donner de raisons et sans aucun préjudice ou pénalité de quelque nature. Vous n’avez qu’à informer le chercheur ou autre personne responsable du projet de votre décision.
- Toute nouvelle connaissance accrue durant le déroulement de l’étude qui pourrait affecter votre décision de continuer d’y participer vous sera communiquée sans délai.
- Le chercheur responsable de l’étude peut aussi décider de vous retirer du projet sans votre consentement si vous ne correspondez pas aux critères diagnostiques de l’étude ou si votre condition physique s’est modifiée.

Personnes à contacter

Si vous avez des questions à poser au sujet de cette étude ou s’il survient un incident quelconque ou si vous désirez vous retirer de l’étude, vous pouvez contacter :
- Christiane Marzini au (514) 343-6111 poste 3378 ou par télérésilieur* (514) 480-3840
- Isabel Roy Infirmière (514) 335-2222 poste 3790 ou télérésilieur/poste 3378 et (514) 230-8703
- Carole Kicey au (514) 343-6111 poste 3378 ou par télérésilieur* (514) 480-3457

approved par le comité d’éthique de la Recherche de l’Hôpital du Sacré-Cœur de Montréal le 2010-01-08
Si vous avez des questions à poser concernant vos droits en tant que sujet de recherche, ou si vous avez des plaintes ou commentaires à formuler, vous pouvez communiquer avec la direction générale de l'Hôpital au (514) 335-2222 poste 3581.

Urgence- Personnes à contacter pour l'étude

Il n'y a normalement aucune urgence prévue avec ce type d'étude. Toutefois, si tel était le cas, vous devrez suivre la procédure suivante: Pendant la durée de l'étude ou après, si vous éprouvez un malaise en relation avec ce projet, veuillez informer un des membres de l'équipe de recherche aux numéros suivants:

1. Dr Gilles Levigne, DMD :  (514) 343-2310
2. Christiane Manzini :  (514) 343-8111 poste 3378 ou
   (514) 480-3340 (télavertisseur pegat de C. Manzini)*
3. Isabel Roy, infirmière :  (514) 335-2222 poste 3790 ou télavertisseur pegat (514) 230-9703

*Pour les télavertisseur : après avoir composé le numéro, vous entendrez le message suivant « après le tonalité veuillez faire votre message numérique ». En utilisant le clavier de votre téléphone à boutons, entrez alors le numéro de téléphone ou vous pouvez vous joindre et raccrochez.

approbé par le comité d'éthique de la Recherche de l'Hôpital du Sacré-Cœur de Montréal le 2010-04-08
Formulaires d'information et de consentement

Consentement du sujet
Évaluation, à l'aide de questionnaires et de l'Actigraphie, les niveaux de douleur, de céphalées, de troubles de sommeil et des troubles neurophysiologiques chez le patient TOCL.

1. J'ai pris connaissance du présent formulaire d'information et du formulaire de consentement éclairé destiné au sujet et je consens volontairement à participer à cette étude.

2. Je reconnais avoir été informé(e) et avoir eu suffisamment de temps pour considérer ces informations et pour demander conseil.

3. Je reconnais que le langage médical et technique m'a été expliqué à ma satisfaction et que j'ai reçu des réponses satisfaisantes à mes questions.

4. Toutes les informations recueillies seront traitées de façon confidentielle et les résultats ne seront utilisés qu'aux fins scientifiques.

5. Je consens à la publication des résultats de cette étude pour autant que les informations demeurent confidentielles et qu'aucune identification ne puisse être faite.

6. J'ai été informé(e) que ma participation à cette étude est volontaire et que je suis entièrement libre de refuser d'y participer et de la possibilité de me retirer de l'étude en tout temps sans que la qualité des soins que je reçois ne soit modifiée.

7. Je recevrai une copie signée du présent formulaire.

Nom du sujet :

(Lettres molles)

Signature : _______________________________ Date : __________

Nom du chercheur ou son représentant :

(Lettres molles)

Signature : _______________________________
Appendix B

Rivermead Post Concussion Symptoms Questionnaire

Programme de traumatologie
Service de psychologie

Questionnaire de Rivermead

Consignes : À la suite d'un traumatisme crânien ou d'un accident certaines personnes éprouvent des difficultés qui peuvent provoquer des inquiétudes ou des incertitudes. Nous désirons savoir si vous souffrez de certains symptômes comme ceux énumérés ci-dessous. Il est possible que certains de ces symptômes aient été présents avant l'accident, comparez donc votre état actuel à votre situation antérieure.

Veuillez NOIRCIR pour chacun des problèmes, le chiffre qui décrit le mieux son intensité.

0 = jamais éprouvé
1 = était un problème avant l'accident, il est demeuré inchangé
2 = est un problème léger
3 = est un problème modéré
4 = est un problème sévère

En comparaison d'avant l'accident souffrez-vous maintenant (dans les dernières 24 heures) de.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Maux de tête</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>2.</td>
<td>Étourdissements</td>
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<td>2</td>
<td>3</td>
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<td>3.</td>
<td>Nausées et/ou vomissements</td>
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<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>4.</td>
<td>Sensibilité exagérée aux bruits</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>5.</td>
<td>Problème de sommeil</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>6.</td>
<td>Fatigue</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Irritabilité, se fâche facilement</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>Sentiments de dépression ou d'être au bord des larmes</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>Sentiments de frustration ou d'impolitesse</td>
<td>0</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>10.</td>
<td>Perte de mémoire ou d'oubli</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>Baisse de la concentration</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>Relâchement de la panse</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>Vision embrouillée,</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>Sensibilité exagérée à la lumière</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>Vision double</td>
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<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>16.</td>
<td>Agitation</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix C

Inventaire Multidimensionnel de la douleur (MPI)

Consignes : Principalement, où avez-vous de la douleur ? (Cocher les zones de douleur qui s'applique à votre situation et noter le chiffre de la zone qui est la plus douloureuse de toutes):

- Tête, visage, bouche
- Région cervicale (cou)
- Épaules, membres supérieurs
- Région thoracique
- Région abdominale
- Dos, région lombaire, coccyx, sacrum
- Membres inférieurs
- Région pelvienne
- Région génitale

Depuis quand avez-vous ce problème de douleur (en mois) (p.ex., 5 mois):

Section 1

À partir des 23 questions suivantes, évaluez votre douleur et la façon dont elle affecte votre vie. Lisez chacune des questions attentivement et indiquez, en notant le chiffre approprié dans l'échelle sous la question, à quel point elle correspond à votre cas.

1. Évaluez le niveau de votre douleur en ce moment.

   - Aucune douleur
   - Douleur très intense

2. En général, à quel point votre douleur nuit-elle à vos activités de tous les jours?

   - Ne nuit pas
   - Nuit énormément

3. Depuis que votre problème de douleur a débuté, à quel point a-t-il changé votre capacité de travailler?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun changement
Changement extrême

4. À quel point votre douleur a-t-elle changé la satisfaction ou le plaisir que vous retirez des activités sociales ou récréatives?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun changement
Changement extrême

5. À quel point votre conjoint vous soutient-il ou vous appuie-t-il en ce qui a trait à votre douleur?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun soutien
Soutien extrême

6. Évaluez votre humeur générale durant la dernière semaine.

☐ ☐ ☐ ☐ ☐ ☐ ☐
Moral extrêmement bas
Moral extrêmement élevé

7. En moyenne, à quel point évaluez-vous l'intensité de votre douleur durant la dernière semaine?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucunement intense
Extrêmement intense

8. À quel point votre douleur a-t-elle changé votre capacité à prendre part à des activités récréatives ou à d'autres activités sociales?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun changement
Changement extrême

9. À quel point votre douleur a-t-elle changé la satisfaction ou le plaisir que vous retirez de vos activités familiales?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun changement
Changement extrême

10. À quel point votre conjoint se fait-il du souci pour vous en raison de votre problème de douleur?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Aucun souci
Souci extrême

MPI 3
11. À quel point avez-vous l'impression d'avoir eu le contrôle sur votre vie, durant la dernière semaine?

Aucun contrôle

Contrôle extrême

12. À quel point souffrez-vous à cause de votre douleur?

Aucune souffrance

Souffrance extrême

13. À quel point votre douleur a-t-elle changé vos relations avec votre conjoint, et avec votre famille?

Aucun changement

Changements extrêmes

14. À quel point votre douleur a-t-elle changé la satisfaction ou le plaisir que vous retirez de votre travail?

Aucun changement

Changements extrêmes

15. À quel point votre conjoint est-il attentif à votre problème de douleur?

Aucunement attentif

Extrêmement attentif

16. À quel point avez-vous l'impression d'avoir été en mesure de gérer vos problèmes durant la dernière semaine?

Pas du tout

Extrêmement bien

17. À quel point votre douleur a-t-elle changé votre capacité à effectuer des travaux ménagers?

Aucun changement

Changements extrêmes

18. Durant la dernière semaine, à quel point avez-vous été irritable?

Aucunement irritable

Extrêmement irritable
19. À quel point votre douleur a-t-elle changé vos relations d’amitié avec des personnes autre que les membres de votre famille?

- 0 : Aucun changement
- 1 : Changement extrême

20. Durant la dernière semaine, à quel point avez-vous été tendu ou anxieux?

- 0 : Aucunement tendu ou anxieux
- 6 : Extrêmement tendu ou anxieux

Section 2

À l’aide de l’échelle figurant sous chacune des questions, noircissez le chiffre indiquant à quelle fréquence votre conjoint(e) (ou la personne la plus près de vous dans votre vie) réagit de cette façon lorsque vous éprouvez de la colère. Veuillez répondre à toutes les questions. Veuillez indiquer la relation qui existe entre vous et la personne que vous avez à l’esprit.

1. Ne porte pas attention.

- 0 : Jamais
- 6 : Très souvent

2. Me demande ce qu’il peut faire pour aider.

- 0 : Jamais
- 6 : Très souvent

3. Me fait la lecture à haute voix.

- 0 : Jamais
- 6 : Très souvent

4. Exprime de l’irritabilité à mon égard.

- 0 : Jamais
- 6 : Très souvent

5. Se charge de ma partie des tâches ou responsabilités.

- 0 : Jamais
- 6 : Très souvent
8. Me fait la conversation pour me distraire de la douleur.

   5  2  1  3  6  3  2  5
   Jamais  Très souvent

7. Exprime de la frustration envers moi.

   5  2  1  3  6  3  2  5
   Jamais  Très souvent

8. Essaie de faire en sorte que je me repose.

   5  2  1  3  6  3  2  5
   Jamais  Très souvent

9. M’incite à prendre parti à une activité.

   5  2  1  3  6  3  2  5
   Jamais  Très souvent

10. Exprime de la colère à mon endroit.

    5  2  1  3  6  3  2  5
    Jamais  Très souvent

11. Va me chercher des médicaments contre la douleur.

    5  2  1  3  6  3  2  5
    Jamais  Très souvent

12. M’encourage à m’adonner à un passe-temps.

    5  2  1  3  6  3  2  5
    Jamais  Très souvent

13. Va me chercher quelque chose à manger ou à boire.

    5  2  1  3  6  3  2  5
    Jamais  Très souvent

14. Ouvre la télévision pour me distraire de ma douleur.

    5  2  1  3  6  3  2  5
    Jamais  Très souvent
Section 3

Voici une liste de 18 activités quotidiennes. Veuillez indiquer à quelle fréquence vous effectuez chacune de ces activités, en notant la chiffre approprié. Veuillez répondre à toutes les questions.

1. Laver la vaisselle.
   - Jamais
   - Très souvent

2. Tondre le gazon.
   - Jamais
   - Très souvent

3. Manger à l'extérieur (au restaurant, chez des amis, etc.).
   - Jamais
   - Très souvent

4. Jouer aux cartes ou à d'autres jeux.
   - Jamais
   - Très souvent

5. Faire le marché.
   - Jamais
   - Très souvent

   - Jamais
   - Très souvent

7. Aller au cinéma.
   - Jamais
   - Très souvent

8. Rendre visite à des amis.
   - Jamais
   - Très souvent

9. Aider à faire le ménage.
   - Jamais
   - Très souvent
Brain Injury and Pain Catastrophizing

10. Entrer dans la voiture.
   | Jamais | 1 | 2 | 3 | 4 | 5 | 6 |
   | Très souvent |

11. Faire une balade en voiture.
   | Jamais |

12. Visiter des membres de la famille.
   | Jamais |

13. Préparer un repas.
   | Jamais |

14. Laver la voiture.
   | Jamais |

15. Quitter la maison pour quelques jours.
   | Jamais |

   | Jamais |

17. Faire la lessive.
   | Jamais |

18. Effectuer les réparations qui s'imposent dans la maison.
   | Jamais |

| # |
| m1 |
Appendix D

Pain Catastrophizing (PC) Scale

Consignes : Chacun d'entre nous aura à subir des expériences douloureuses. Cela peut être la douleur associée aux maux de tête, à un mal de dent, ou encore la douleur musculaire ou aux articulations. Il nous arrive souvent d'avoir à subir des expériences douloureuses telles que la maladie, une blessure, un traitement dentaire ou une intervention chirurgicale.

Dans le présent questionnaire, nous vous demandons de décrire le genre de pensées et d'émotions que vous avez quand vous avez de la douleur. Vous trouverez ci-dessous treize énoncés décrits différentes pensées et émotions qui peuvent être associées à la douleur. Veuillez indiquer à quel point vous avez ces pensées et émotions, selon l'échelle ci-dessous, quand vous avez de la douleur.

<table>
<thead>
<tr>
<th>Échelle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Pas du tout</td>
</tr>
<tr>
<td>1</td>
<td>Quelque peu</td>
</tr>
<tr>
<td>2</td>
<td>Morallement</td>
</tr>
<tr>
<td>3</td>
<td>Totalement</td>
</tr>
</tbody>
</table>

0. o o o o j'ai peur qu'il n'y aura pas de fin à la douleur.
1. o o o je sens que je ne peux pas continuer.
2. o o o c'est terrible et je pense que ça ne s'améliorera jamais.
3. o o o c'est affreux et je sens que c'est plus fort que moi.
4. o o o je sens que je ne peux plus supporter la douleur.
5. o o o j'ai peur que la douleur s'empire.
6. o o o je ne sais pas penser à d'autres expériences douloureuses.
7. o o o avec inquiétude, je souhaite que la douleur disparaisse.
8. o o o je ne peux m'empêcher d'y penser.
9. o o o je ne sais pas penser à quel point ça fait mal.
10. o o o je ne sais pas penser à quel point je veux que la douleur disparaisse.
11. o o o il n'y a rien que je puisse faire pour réduire l'intensité de la douleur.
12. o o o je me demande si quelque chose de grave va se produire.